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ORIGINAL COMMUNICATIONS.

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I.—*The Natural History of the British Entomostraca.* By WILLIAM BAIRD, Surgeon. Plates VIII. IX. X. (Continued from p. 41.)

IN my former paper, I gave a short general history of the "Entomostraca,"—a brief account of the authors who have noticed them particularly; and some general observations on their habits and manners. I also mentioned some of the various systematic arrangements which have been adopted by different authors, and stated the uncertainty which still exists as to their proper arrangement in a general system. In particular I described the arrangements of Latreille in the last edition of Cuvier's Règne Animal, and of Milne Edwards in his late work on the Crustacea, which latter I proposed adopting. The second volume of M. Edwards's work, however, in which the Entomostraca are to be treated of, not having yet been published, it will be necessary to follow Latreille's method in detail; and thus the first genus which I shall give a monograph of, is the genus "Cyclops:"—

Class.—CRUSTACEA.—Division, ENTOMOSTRACA.

Ord. BRANCHIOPODA.—Section, LOPHYROPA.—Group, CARCINOIDA.

Genus, CYCLOPS.\*

*Bibliographical History.*—The first notice of any animal of this genus that I am aware of, is to be found in a little work of Stephanus Blancardus, the "Schou-burg der Rupsen, Wormen, Ma'den, &c.," published at Amsterdam, in 1688. His notice of it, however,

\* "Class, Crustacea; Sub-Class, Maxillés; Legion, Entomostraca; Order Copépodes."—Milne Edwards.

is very brief, and the figure which he gives is very bad; being barely sufficient to enable us to make out that it is the *Cyclops quadricornis* that it is meant to represent. Leeuwenhoek appears to have been the first to have taken any lengthened or particular notice of the genus. In his "Epistolæ ad Societatem Regiam Anglicam," &c. (*Epistola* 121, written in 1699,) he gives a good many details of an insect which he found in fresh water, and whose habits he seems to have studied with considerable attention. He gives a figure of it also, which, though far from being correct, suffices to shew us that his insect is also the *C. quadricornis*. His observations upon it are very interesting, and he discovered amongst other things worthy of note, the great difference there is between the young and old insects, though he did not carry his observations so far as to trace the transformations which take place. In "No. 283 of the Philosophical Transactions, for January and February 1703," the same author gives a description of a polype (the *Hydra viridis* of Muller) growing upon the *Lemma* or duck-weed, which calls forth another paper from an anonymous correspondent in "No. 288 for November and December 1703," in which the writer mentions his having frequently observed the same polype growing upon insects, especially upon "two sorts of the crustaceous kind." These two species of insects, which he states are *monoculous*, he gives figures of, sufficiently correct to shew them to be the *C. quadricornis* and *Castor*, the first being a tolerable figure, though the second is very indifferent. The same writer also takes notice of a third insect of the same genus, which is much smaller and like a shrimp, but which he could never figure, evidently the *C. minutus*. Baker in his "Microscope, made easy, 1743," makes a few remarks upon these same insects, and copies the figures from the Philosophical Transactions, and in his "Employment for the Microscope, 1764," he publishes a letter from a correspondent, who gives a variety of details with regard to the insect which Leeuwenhoek describes, finds great fault with his figure, but gives a much worse one himself! De Geer in his "Memoires pour servir à l'histoire des Insectes," Vol. vii. published in 1778, is the next author, I believe, who has entered into any details with regard to any of the insects of this genus. He describes at considerable length, and figures with tolerable accuracy, the *C. quadricornis*, and confirms many of Leeuwenhoek's statements with regard to it, particularly the great difference between the old and the young insect. Otho Fredericus Muller,\* is the next succeeding author who has particularly noticed this genus. Previous to his time,† with the exception of de-

\* Entomostraca, seu Insecta testacea, &c. 1785.

† "Unicum quidem ante annum 1769, quo in *Synopsi Monoculorum* quatuor

tached notices such as I have mentioned above, *one* species only of this genus seems to have been noticed by authors, which, like all the other Entomostraca then known, was arranged, and described under the general name *Monoculus*. He was the first to divide the different animals which figured under this name into distinct genera; and having discovered in the marshes, and on the shores of Denmark and Norway, a variety of species all agreeing in generic characters with each other, he formed them into one distinct genus, and gave the name of *Cyclops* to it. He has given a great many interesting particulars of many of these little creatures, but has fallen into two or three mistakes concerning them, which will be pointed out hereafter. Sometime after Muller, Ramdohr, in 1805, published in his work on the *Monoculi*\* a very correct account of the anatomy, &c. of three of the species of this genus found in fresh water, accompanied with plates, which possess very considerable accuracy; and traces their whole transformation from the egg to the perfect insect. Louis Jurine (pere)† is the last author whom we shall mention, and is the one who, of all that have written upon this class of insects, has given us the fullest, most interesting, and most accurate information upon the fresh water species of this genus; and though he declines the name of *Cyclops*, which Muller had given it, and prefers the old term *Monoculus*, he has cleared up the mistakes which the former has fallen into, and completed, by a series of wonderfully careful experiments, the previous discoveries of Leeuwenhoek and De Geer. He takes no notice of the labours of Ramdohr, and seems to be ignorant of his discoveries, though the work of Ramdohr preceded his by fifteen years.

*Anatomy* ‡.—In general form and appearance, the genus *Cyclops* approaches nearer to the terminating series of the *Malacostraca*, than do any other of the Entomostraca. § The body of the animal, which is soft and gelatinous, is inclosed within a horny shell, which covers it like a buckler, but opens inferiorly to give issue to the antennæ, organs of the mouth and feet. In general the body and tail are pretty easily to be distinguished from each other, and are composed of about ten segments, the body generally having four, and the tail six. In the upper or *cephalo-thoracic* segment of the body, which

novos Cyclopes fluviatiles publici juris feci, nempe Monoculus quadricornis Entomologis innotuit.”—Entomost. p. 100.

\* Beiträge zur Naturgeschichte einiger deutschen Monoculus-arten,—4to, Halle, 1805.

† Histoire des Monocles qui se trouvent aux environs de Genève.—1820.

‡ I have, in a great measure, followed Jurine in the anatomical *nomenclature*, adhering as closely as possible to the *terms* he uses.

§ “Canceris macrouris maxime accedunt structura corporis pedum et antennarum, &c.” Muller, p. 100.

is usually much the largest of all, we find the eye, the antennæ, mandibles, mouth, one pair of organs which Jurine calls hands, and one pair of feet. The eye is situated near the upper extremity of this first segment, and in the centre. It is generally pretty large, and is single. In *C. Castor* we can perceive the muscles which move it, and which are pretty numerous; the eye itself is of a beautiful ruby colour. The antennæ are four in number. The superior antennæ arise from the upper portion of the segment, on each side of the eye; they are always larger than the inferior pair, and are generally composed of numerous articulations, which are plentifully supplied with short setæ; the number of articulations differ in each species. The male is distinguished by a peculiarity in the antennæ, which at once marks the sex. In general they are shorter and thicker than in the female, and either one, the *right* one, as in *C. Castor*, or both, as in *C. quadricornis*, &c. have a swelling near the centre, or towards the extremity, followed by a moveable joint, which acts like a hinge, and which serves a very useful purpose in the act of copulation. The inferior antennæ, or antennules, are situated immediately beneath the preceding, and are composed of fewer articulations. Both of these organs are made use of by the animal to assist itself in progressive motion. Immediately below the antennules are the internal mandibles, which may be described as consisting of three parts, body, neck,\* and “barbillon,” but differing from each other in several respects in the different species. In the *C. quadricornis* are two organs, partly covering these, which Jurine calls external mandibles, † and which do not exist in the other species; and in the *C. Castor* and *minutus* again, are to be seen two round bodies which open and shut during the time the animal is taking food, and which do not exist in the *quadricornis*; these Jurine calls lips. The action of the internal mandibles is to reduce the objects of food when large into small pieces, fitted to pass by these lips into the mouth. Below the mandibles are situate two organs, which Jurine calls hands; a term which Muller had already applied to the same organs in one marine species he describes, the *C. chelifera*. ‡ All the species of the genus possess these organs. They are always situated in the same place; but all differ from each other in so many respects, that it will be necessary to describe them in each species separately. The use of these organs, according to the author I have already quoted so often, is to push constantly towards the mouth a

\* Prolongation of Jurine.

† “Mâchoires.”—Latreille.

‡ “Entomostraca.”—P. 114.



current of water, carrying along with it the particles destined for the insect's food. Immediately beneath the hands are situated the first pair of feet. They are double, consisting of two stalks arising from a common base, each stalk consisting generally of from two to four articulations, more or less furnished with setæ, but varying very much in different species, especially the marine ones. Attached to the next three segments of the body, and arising from the interstices between each, we find three other pairs of double feet, in general resembling each other exactly. These feet act as true fins, and as they are not at all used by the insect for *walking*, the term *feet* is not so correct as that of *fins*. In the tail we find placed the organs of generation and their appendages. In the first segment, we observe in the female two organs, which differ in appearance in each species, and which, as their use is to give support to the oviducts which furnish the envelope of the external ovaries, are called by Jurine, "les supports, ou fulcra." At the junction of the second ring with the third in the same sex, in the *C. quadricornis*, is situated the vulva; this opening forms also the mouth of the *canalis deferens*, which communicates directly with the internal ovary, and gives passage to the eggs. In the male of this species, we find the genital organs situated also in the second segment of the tail, consisting of an oval body or papilla, which gives origin to a prolongation of three short segments. In most of the other species the male organs appear to be situated in the corresponding segment to that in the female, which carries the "fulcra," or "supports." The external ovary, or bag of eggs, springs from where the second segment articulates with the third, and is attached to it by a very slender pedicle. The internal ovaries consist of an opaque mass of solid-looking matter, composed of numerous round globules of a dark brown colour, disposed round the alimentary canal, and occupying a considerable space of the interior of the body. This, as I have already stated, has a direct communication with the opening at the junction of the second with the third segment of the tail, the *canalis deferens* of Jurine; and it is through this canal that the eggs pass into the external ovary. The alimentary canal is very perceptible, beginning behind at the place which I have mentioned as the situation of the lips, and terminating at the extremity of the tail. In the *C. Castor* the heart is very distinctly to be seen under the second and third segment of the body. It is oval, and gives origin to two vessels of equal size, one going to the head, and the other to the tail, and has another organ attached to it, which Jurine considers the auricle. The pulsations of the heart are very frequent, from 112 to 120 in the minute.

*Habits, manners, &c.*—The insects which belong to this genus are to be found both in the fresh water and the sea. The fresh water species abound in the muddiest, most stagnant pools, and in the clearest springs,—and the ordinary water with which the inhabitants of London are supplied for domestic purposes, contains them often in great numbers. The marine species are to be found, often in immense abundance, in small pools on the sea shore, within high water mark, living amongst the sea weeds and corallines, which frequently fringe so elegantly the beautiful little wells and clear round pools which are hollowed out in the rocks by the sea shore, and are equally abundantly to be met with in the open ocean, where, by the curious luminous properties they possess, they assist in producing that beautiful phosphorescent appearance of the sea, which has so much puzzled naturalists to discover the cause of. It is amazing, when we examine the pools of water which are to be met with in our fields, or sea shores, to find such infinite myriads of little creatures sporting about in all the enjoyment of existence—and it is exceedingly curious and interesting to know the extraordinary fertility of such apparently insignificant creatures. Specimens of the *quadricornis* are often to be met with carrying thirty or forty eggs on each side,\* and though the other species which have only one external ovary, do not carry so many, still the number is very considerable. Jurine has with great fidelity watched the hatching and increase of the *quadricornis* in particular, and has given a calculation which shews the amazing fertility of the species. He has seen one female, isolated, lay ten times successively—but in order to be within bounds, he supposes her to lay eight times within three months, and each time only forty eggs. At the end of one year this female would have been the progenitor of 4,442,189,120 young!! The first mother lays forty eggs—which at the end of three months, at eight layings during that time, would give 320 young. Out of this number he calculates 80 as males, (there being in every laying a great proportion of females,) the remaining 240 are females. The following table will then shew the prodigious extent of their fecundity:†

\* Leeuwenhoek says, that in the specimens which occurred to him of the *quadricornis*, he counted the eggs to be three or four in breadth and nine or ten in length. Epist. ad. Soc. Reg. Ang. p. 138.

† Jurine, Hist. des. Monoc. &c. p. 32.

	No. of layings.	Time employed for these 3 layings.	Total — each laying supposed to be of 40 young.	Subtract for males.	Females remaining.
1. mother	8	From 1st Jan. to end of Mar.	320	80	240
1. family, of females 240	8	From 1st Apr. to end of June.	76,800	19,200	57,600
2. family, of females 57,600.	8	From 1st July to end of Sep.	18,432,000	4,608,000	13,824,000
3. fam. of fem. 13,824,000.	8	From 1st Oct. to end of Dec.	4,423,680,000	1,105,920,000	3,317,760,000
			4,442,189,120	1,110,547,280	3,331,641,840

A single copulation suffices to fecundate the female for life. The male seems very ardent in his amours. By way of prelude, he seizes hold of the hinder feet of the female with his antenna, which being furnished at its extremity with the hinge joint, already described, forms a fastening round her feet which she cannot unloosen by any exertion—and thus he is carried about with great rapidity for some time. The female, however, at length stops, wearied by her exertions, when the male seizes the favourable moment, and in the twinkling of an eye (as Jurine expresses himself) makes a double copulation—one on each side. According to Muller, the male organs are situated in the swellings which we perceive in one or both antennæ of that sex, and which are characteristic of it. Carried away by the analogy of the *Arachnides*, and seeing the male seize hold of the lower part of the female with his antennæ, he immediately conjectured that the organs resided in the swellings which mark the antennæ of the male, and were applied to the vulva, which he correctly enough states to be situated in the tail.\* This mistake, however, Jurine has cleared up, having shown the organs in both sexes, and watched the act of copulation itself. When the mother is about to lay, we may perceive the material of the eggs, which I have described above under the name of internal ovary, divide into two columns, one on each side, and pass through the *canalis deferens*, covered with a fine pellicle, which forms the sac in which the eggs are contained when extruded. This bag of eggs, or external ovary, remains suspended at the tail of the female for several days, varying from two to ten according to temperature of weather, &c.† The eggs themselves during their sojourn there do not increase in

\* Entomostraca, p. 16–17.

† Leeuwenhoek says they exclude their ova in the space of one day or night, and bring them to perfection in the space of three days.—(Epist. ad Soc. Reg. Ang.)

size, but undergo various changes in colour, &c. and at the proper time the ovary opens, and the young ones are ushered forth into life, as unlike the parent as can well be imagined. I have already said that Leeuwenhoek had noticed this difference between the young and old, and upon first observing it, he seems to have been much surprised at the unexpected discovery. He repeated his experiment, therefore, of separating an insect with the ova attached to the tail, and found the same result. "Ea hisce visis," he concludes, "certa mihi persuasi ea animalcula, quæ jam oculis meis observabantur, ex ovis illis nata esse."\* He watched them for seven or eight days, and found them increased in size—but here, when just on the threshold of discovery, he seems to have stopped, and he makes no farther mention of a continuation of his observations. De Geer also noticed this curious fact—confirms the observations of Leeuwenhoek as far as they went—gives figures of the young at different stages of their growth—but stopped short in his observations also, after having watched them about fifteen days. Notwithstanding this Muller could not persuade himself that such dissimilar creatures could be the same, and he has accordingly, without giving sufficient credit to these illustrious men, or watching the hatching and progress of the young himself, formed these imperfect insects into two different genera, which he has called Nauplius and Amymone.† Ramdohr and Jurine, however, have both clearly rectified this mistake, and fully corroborated the assertions of Leeuwenhoek and De Geer, by following out the transformations in all their extent. The time occupied in this process varies much according to the season of the year, and the temperature. This latter I have found produces an amazing difference in the length of time so occupied, and I have no doubt also, from my experiments, that the process has been retarded or hastened on, according as the vessel in which they have been kept has been placed in a light or a dark situation. According to Jurine, the time occupied in the case of the *C. quadricornis* has never been less

\* Epist. ad Soc. Reg. Ang. p. 139.

† Entomostraca, pp. 39–48, Plates i. and ii.—It is stated by Latreille, and echoed by some other writers, that the *Amymone* of Muller is the young of the *Cyclops* in its earliest state, when it has as yet only four legs, and that when it receives the additional pair it then becomes the *Nauplius*. This is not correct. The different species of *Amymone* are the young of the *C. minutus* in different stages, and of one or two of the marine species; and never assume the form of the *Nauplius*. The *Nauplius* (at least the *N. saltatorius*) is the young of the *C. quadricornis*, which at its earliest stage resembles fig. 3 of plate 1. of Muller. The *N. bracteatus* I have never seen, and do not know.



than twenty days, and in a series of very careful experiments which he made in February and March, he found it to occupy twenty-eight days. For the first eight days, they underwent little or no change—between the eighth and thirteenth the body appeared a little more elongated—between the thirteenth and nineteenth, the line of demarcation between this increase of length and primitive size was traceable by a line of a brown colour, and the insect had acquired a third pair of feet—between the nineteenth and twenty-fifth, no great change took place, only the third pair of feet were more developed—between the twenty-fifth and twenty-eighth the first moulting took place—and thirteen days afterwards they moulted a second time. In a series of experiments which I undertook, upon the same species, in the end of June and beginning of July, when the thermometer was frequently above 80° during the day, I found the time occupied in the process, in some instances, very much shortened. In one brood which were hatched on the 21st of June, I found some had completed their first moulting on the 1st of July, or on the eleventh day. In another brood hatched on 22d June, I found the same result, several of the young having undergone a first moulting on the 2d July. On the 4th I could only see one that had not moulted—and next day, the 5th, this one had also undergone the change: the second moulting in many of them took place only a few days after the first. In another brood hatched a little earlier in June when the weather was not so hot, I found the changes take place as follows: When hatched the insect appeared of an oval shape, (Plate VIII. Fig. 9,) having two thick antennæ of three articulations each; two pairs of feet, bifid at extremity; in the upper pair, one division consisting of two and the other of only one articulation; in the lower, both divisions having only one articulation; extremity of body furnished with two short setæ on each side. On the eighth day, the body is considerably elongated, and a distinction has begun to be perceptible between this increase and original size, with some appearance of setæ where the third pair of feet afterwards appear; intestine very distinct, (Fig. 10.) On the fifteenth day, the third pair of feet have become distinctly formed; the lower part of body more elongated, the elongation marked by another line of demarcation; the setæ on the edges of the antennæ have become visible, and those of the feet longer and more numerous, whilst the second pair of feet have the upper division of two articulations, (Fig. 11.) On the seventeenth day, moulting has taken place—the body is divided into two segments; tail into three; the terminating one cleft at extremity, each cleft sending off a long seta; antennæ of about six articulations; the antennules have become distinctly visible, and the feet have assumed the appearance they after-



wards bear, (Fig. 12.) At each moulting the number of segments into which the body and tail are divided increase in number; the number of articulations and the length of antennæ increase, &c., but it is not till after the third moulting that the insect is perfect and capable of producing its species.\*

A question has been started whether the *Cyclops* should be considered oviparous or viviparous insects; and it appears to be one of some difficulty, as they would seem from what I have stated to be both. Geoffroy states that all the *Monoculi* are oviparous.† De Geer also says they are oviparous. "However," he immediately adds, "as the *Monoculi* never quit their eggs before the young ones are hatched, we may perhaps regard them as viviparous."‡ Jurine says it is difficult to decide. Viviparous young, he says, increase in size every day, and have constant need of a mother's care—if she die, all die. As, however, the young of the *Cyclops* do *not* increase in size after passing from the internal ovary, and as, from numerous experiments which he details, they were found, after having passed into the external ovary, to be independent of the life of the mother, even if she were killed by spirits of wine—they must, he concludes, be considered oviparous. §

The process of moulting, under which the little creature frequently succumbs, is both interesting and curious. The new shell or

\* The recent alleged discoveries of Mr Thompson, of the metamorphoses which the young of several genera of the *Cirrhipedes* and *Crustacea* undergo, have excited a good deal of attention of late to this very interesting subject. According to Mr Thompson, the genus *Zoea* of Bose, which figures away in many of our arrangements, as one of our Entomostraca, is nothing more nor less than the larva of the common crab, in its first state. (Vide Zoological Researches, No. I. and succeeding.) M. Burmeister has verified Mr Thompson's discoveries with regard to the metamorphoses which the *Cirrhipedes* undergo; but many doubts still continue to be thrown upon his observations with regard to the genera of *Crustacea*. One or two genera of each of the great groups of the *Malacostraca* have been apparently satisfactorily ascertained to undergo no metamorphosis—and the labours of M. Rathke, with the observations of other writers, and especially of Mr Westwood, in a paper published in the Philosophical Transactions for 1835, leave the matter still in doubt, and show the necessity of Mr Thompson's observations being confirmed before this interesting question can be settled. The insects of the genus *Cyclops* approach so near to some of the *Malacostraca*, however, that were we to reason from analogy alone, we might easily conceive Mr Thompson's discoveries to be partly confirmed—as the changes which they undergo are almost equally wonderful with any of the genera which he has made the subject of his observations.

† Histoire abrégée des Insectes, p. 654.

‡ Mem. pour servir à l'hist. des Insectes, Vol. vii. p. 435.

§ Hist. des Monoc. p. 17.

covering having grown under the old one, when the process of changing it commences, the insect fastens itself to the bottom or side of the vessel in which it is, or to any solid object near it, so as to give itself support. It then, by moving its limbs, and shaking the valves of the shell, the new parts at the same time coming forward, loosens the old covering, and in a short time frees itself from the exuviae altogether, leaving behind, the sheaths of the limbs, hairs, plumes, and even the minute setulæ that almost escape the power of the microscope itself from their fineness, such as the delicate plumose setæ which adorn the long filaments of the tail. "How, beyond all idea," says Muller, from whom I have taken this description, "this most subtle fineness, for they are sheaths containing other smaller sheaths, which again include other organs smaller still."\* The number of times they moult during life is not known, but Jurine says, they ordinarily, though not always, moult before each time of laying eggs. They certainly do not always do so; and perhaps the frequency of their moulting may depend much upon the temperature, the seasons, &c.

Having the experiments of Spallanzani and others, upon the reproduction of mutilated members in various animals, before his eyes, M. Jurine instituted a series of experiments upon the *C. quadricornis*, to see how far this power existed in this genus of insects. In most of his experiments he failed, the insects having died before they moulted, and without showing any evident change in the mutilated members. At length he succeeded. He cut off about two-thirds of an antenna in a female which lived and moulted, reappearing, after moulting, with a beautiful perfect new antenna, the old one of the cast shell not having shown the least indication of a change.†

Some authors have asserted that these insects possess a wonderful power of resisting drought, and that when, by reason of the summer heats, the marshes become dried up, the little creatures do not die, but as soon as the mud becomes moistened by the rain, they recover entirely. Jurine, however, doubts this, and instituted a series of experiments to prove that they have not this faculty. He selected 12 of the *C. quadricornis*, removed them out of the water, and allowed them to remain fifteen minutes dry; 7 of them he found to be irrecoverably dead, the remaining 5 recovered. Again he selected 12 others, and allowed them to remain twenty minutes dry—11 out of the 12 died. A third time he selected 12, and after expos-

\* Entomostraca, p. 9.

† Hist. des Monoc. p. 40.

ing them in a state of dryness for twenty-five minutes, he found that all had irrecoverably perished.\*

Their power of resisting the action of cold, however, according to Muller, is much greater than their power of defying drought. In an experiment which he details, he says, that he exposed some individuals of the *C. quadricornis* in a glass vessel to a freezing air, and that when fully frozen, he continued the exposure for twenty-four hours. At the end of that time he placed the vessel containing their frozen bodies in a warm bath, watching the effect of this upon them frequently during the succeeding twenty-four hours, but without seeing any motion. Next morning, however, upon looking into the vessel, he observed, not without wonder, the insects alive, and swimming about as before congelation, the females with their bags of eggs adhering to them as usual; † they did not all recover, but the greater part were restored to life. In some other similar experiments upon these insects, especially the *C. castor*, throwing them into a state of asphyxia by means of spirit of wine, and then restoring them to life again, Jurine found that the first part of the body to show irritability and a return of motion was, not the heart, as perhaps might be expected, but the alimentary canal—the heart seems to be next—then the antennæ, and last, the feet.

De Geer asserts that the *Cyclopes*, along with the other Monoculi, are nourished by animalcules. Leeuwenhoek, in addition to this, asserts that when in want of other food they devour their own young. De Geer also says, that he has seen this frequently to be the case. Jurine has repeatedly seen the same, but says, in vindication of his beloved insects, that it would appear from what he has noticed, that they do not do so *from taste*, but that the helpless young cannot resist the action of the whirlpool the mother causes around her, and are thus carried unconsciously into the old one's mouth. I have also frequently noticed the sudden disappearance of the young when no other insects were in the vessel but their mother, and who, it is most probable, must have devoured them, and from what I have noticed, I think the variety *albidus* of the species *quadricornis* is the one which possesses this carnivorous propensity in the greatest degree. Muller, however, maintains that the *C. quadricornis*, as well as others of the Entomostraca, live upon vegetable food; and I have mentioned in my former paper (page 40) the experiment he instituted upon the sub-

\* Hist. des Monoc. p. 39.

† Entomostraca, pp. 5, 6.

ject.\* That he is wrong cannot be doubted, I imagine, and there is every reason to presume, that their being carnivorous serves a most useful purpose in the economy of nature. The adults in their turn fall victims to, and are devoured by, other insects, the chief of which are the Hydrachnæ, Hydræ, and larvæ of aquatic insects, which destroy them in such vast numbers, as in some measure to counterbalance the most extraordinary fertility which they possess, and which I have already mentioned above.

*Species.*

A. *Fresh Water Species.*

1. *Cyclops quadricornis*.—Plate VIII. Fig. 1, 1-14.—*Specific character*—Antennis longis; corpore ovato; cauda recta bifurcata; furcâ utrâque setis quatuor plumosis instructâ; ovariis externis duobus.

*Synonimes, &c.*—*Cyclops vulgaris*, *Desmarest*, Considerat. generales sur les Crustacés, p. 362.

*Monoculus quadricornis*, *Jurine*, Hist. des Monoc., &c. 1820, pp. 1-49. Plates 1, 2, 3.—*Figures excellent.*

*Cyclops quadricornis*.—*Ramdohr*, Beyt. zur Naturg. einigen deutschen Monocarten, 1805. Pp. 1-6, t. 1, fig. 1-10; t. 2, f. 1, 3.

*Cyclops quadricornis*—*Muller*, Entomostraca, &c. p. 109, tab. 18, fig. 1-4, 1785.—*Figure pretty good.*

*Nauplius saltatorius*, (the young in its first state,) *Muller*, Entomost. p. 40, tab. 1. fig. 3-7.

*Eichhorn*, Beytrage zur Naturgeschichte dar Kleinsten Wasserthiere, p. 54, tab. 5, fig. m. n. 1781.—*Very bad figure.*

Le Monocle à quatre cornes, *De Geer*, Memoires pour servir à l'histoire des insectes, tom. 7, p. 483, plate 29, fig. 11-12, (adult insect,) plate 30, fig. 5-9, (egg and young,) 1778.—*Figures not quite correct.*

*Monoculus quadricornis*, *Fabricius*, Systema Entomologiæ, p. 295, 1775.

Der Naturforscher, *Stuck* 5, p. 247, 1775.

Neue Mannigfaltigkeiten, i. p. 640, fig. 3, 1774.—*Figure apparently copied from Roesel.*

Le Monocle à queue fourchue, *Geoffroy*, Hist. abrég. des Insectes, Vol. ii. p. 656, No. 3, plate 21, fig. 5, 1764.—*A very bad figure.*

*Pediculus aquaticus*, *Baker*, Employ. for Microsc. p. 383, pl. 15. fig. 1-4, 1764.\*

*Monoculus quadricornis*, *Scopoli*, Entomologia Carniolica, p. 413-1139, 1763.

*Monoculus Apus*, *Poda*, Insecta Musei Græcensis, p. 125, tab. 1. fig. 11, 12, 1761. †

\* *Geoffroy* also says, that *all the Monoculi* live upon vegetable matter alone.—Hist. abrég. des Insect. Vol. ii. p. 654.

† *Baker's* correspondent complains sadly of the figures which *Leeuwenhoek* gives, as being very incorrect, and yet the figures which he gives are ten times worse than *Leeuwenhoek's*!!

‡ The name of *Mon. Apus* is given incorrectly by *Poda*, as his figure, though very indifferent, is clearly that of the *C. quadricornis*.



*Roesel*, der Insecten Belustigung, Tom. iii. p. 606, tab. 98, fig. 1, 2, 4, 1755. \*  
*Monoeculus quadricornis*, *Linné*, Fauna Suecica, No. 2049, 1746.

*Baker*, Microscope made easy, p. 93, plate 9, fig. 1, 2, 1743. *Figures copied from Philos. Transact.*

Philosophical Transactions, No. 288, accompanying plate, fig. 5, 1703.—  
*Figure tolerably correct.*

*Leeuwenhoek*, Epistolæ ad Societatem regiam anglicam, p. 142, fig. 1, 2, 3, 1699.—*Figure incorrect.*

*Blancardus* (Stephanus) Schou-burg der Rupsen, Wormen, ma'den, &c. p. 151, tab. 13, fig. B. 1688.—*A very bad figure.*

*Habitat.*—Standing water, every where, all the year round.

*Description.*—From 7–12ths to 9–12ths of a line long.—Body (Plate VIII. Fig. 1. *a*.) of four segments. Tail (*b*) of six—the latter terminating in two lobes. First ring of body much larger than any of the others, being equal in size to the other three. Second and third nearly equal in size, the fourth being smallest. Antennæ (*c*, *c*.) of numerous articulations, from seventeen to twenty; each articulation throws forward a seta, sometimes two. In male, both antennæ (Fig. 2, *a*, *a*.) possess a peculiar swelling and hinge-joint. Antennules (Fig. 1, *d*, *d*.) of four articulations, each furnished with several setæ, terminating one having six, of unequal length. Internal mandibles (Fig. 4.) composed of three parts, body (*a*.) neck (*b*.) and “barbillon” (*c*.) Body of an ovoid shape, convex on upper and concave on under surface, in which concavity is lodged its motor muscle. Neck, a sort of petiole turned upon itself, and dilated at extremity, in which are implanted six pretty strong teeth. “Barbillon,” composed of one ring and two long filaments. External mandibles (Fig. 5.) situate a little behind the others, convex externally and concave internally, give origin to several filaments and processes, and are terminated by two strong horny teeth. This organ does not exist in the other species. Hands; (Fig. 6.) each is divided to the base into two parts; the internal (*a*.) which Jurine compares to a thumb, is much smaller than the other, is formed of three articulations, the two first of which have on inner edge several pretty strong plumose spines or setæ, while the third, which is much the smallest, is terminated by three spines. External division (*b*.) is also composed of three articulations, upon the first of which reposes the thumb; the second is much longer, and has on

\* The figure of the Cyclops is given in this plate by Roesel, chiefly as being the resting-place for a species of polype which he describes, and with which, as often happens, the body of the insect is almost completely covered. Though not *very correct*, it is much superior to the figures given by Eichhorn, Baker, Geoffroy, &c. and really forms with its clusters of polypes a very pretty plate.



internal side, a tubercle from which issues a plumose spine; the third, the smallest, consists of three parts, the middle piece triangular-shaped, divided into two strong spines; the internal, situate at its root, giving origin to a long and strong spine, which, near the middle, gives off another; and the external, which is cleft into two strong spines. These five strong spines are called fingers by Jurine, but, as represented in the accompanying plate, sketched as they occurred to me, they differ very widely in appearance from the fingers represented by him in his figure of these organs; \* and though most of the other parts of the insect, as given in his plates, are very correct, I cannot help thinking, however much indebted we may be to the fair artist, that the representation of these parts borrows a good deal from Mademoiselle Jurine's imagination. Feet (Fig. 1, *e*, Fig. 7,) eight in number, or four pairs; each foot is double, or composed of two stalks arising from a common base; each stalk consists of three articulations, and each articulation is furnished with plumose setæ, the terminating one having six or seven. The first pair of feet do not differ from the rest. First ring of tail is very small. In the male (Fig. 13,) the second ring is the largest, while in the female (Fig. 1,) it is the third. The last gives off two long lobes, making the tail appear bifurcated, each lobe giving origin to four plumose setæ, the two intermediate of which (Fig. 1, *f*, *f*.) are much the longest, and have near upper extremity a small joint, which adds much to the suppleness of these fine organs. The fulcra or supports, in this species, are very small. Male organs of generation (Fig. 13, *a*, *a*.) are two oval bodies, situate on each side of second articulation of tail, and terminating in a prolonged point. Internal ovaries (Fig. 14, *a*, *a*.) pretty large and divaricate. External ovaries (Fig. 3,) of same colour as adult, and containing in an old female thirty or forty eggs on each side.

Jurine makes five distinct varieties of this species, † three of which I have frequently seen in this country. 1. *Rubens*, 7-12ths of a line long without the tail filaments; of a reddish colour; external ovaries of same colour as adult animal, (Fig. 14,) 2. *Albidus*, 8-12ths of a line long; of a light-grayish colour; external ovaries nearly at a right angle with tail, (Fig. 3;) body more rounded than in *Rubens*; male one-third less than female. 3. *Viridis* (Fig. 1,) 9-12ths of a line long; largest of all the varieties; of a green colour, more

\* Plate 2, Fig. 6, 7.—The figure of these organs, as given by Ramdohr, tab. ii. fig. 2, of his work, though not altogether correct, is much nearer the truth than that of Jurine.

† “ Variat colore albida, fulvescente, viridi et rubro.”—Muller, p. 112.

or less deep; external ovaries not so much at a right angle with tail as preceding.

2. *Cyclops Castor*. Plate X. Fig. 1.—*Specific Character*.—Antennis longioribus; cauda bifurcata; furcâ utrâque setis quinque plumosis instructâ; ovario externo unico.

*Synonimes, &c.*—*Dioptomus Castor*, *J. O. Westwood*, *Lardner's Cabinet Cyclopædia* (ined.)

*Cyclops Castor*, *Desmarest*, *Consid. gen. sur les Crustacés*, p. 363.

*Monoculus Castor*, *Jurine*, *Hist. des Monoc.* pp. 50–73, plates 4, 5, 6. 1820.

*Figures beautiful.*

*Cyclops lacinulatus*, *Ramdohr*, *Beyt. zur Naturg.* pp. 7–9, tab. ii. fig. 4–12. 1805.

*Monoculus Cæruleus*.—*M. rubens*, *Fabricius*, *Entom. System.* 1792.

*Cyclops Cæruleus*, *Muller*, p. 102, tab. xv. fig. 1–9.—*C. rubens*, *Muller*, p. 104, tab. xvi. fig. 1–3.

*C. lacinulatus*, *Muller*, p. 105, tab. xvi. fig. 4–6. 1785. *Figures tolerable.*

*Baker*, *Microscope made easy*, p. 93, pl. 9, fig. 2, 1743.—*Figures copied from the Phil. Trans.*

*Philosophical Transactions*, No. 288, fig. 6 of accompanying plate. 1703.

—*Very bad figure.*

*Habitat*.—Ponds and slowly-running water, as at Dunglass Pond, Yetholm Loch, &c. &c. in Scotland; New River, London. Not so common as preceding species.

*Description*.— $1\frac{1}{2}$  long. Body of six articulations; first largest. Tail of five; the last sending off two lobes, each of which gives origin to five plumose setæ. Eye large, of a fine ruby colour. Antennæ large and strong, of about twenty-six articulations; each segment furnished with one or more setæ; last one terminated by five unequally long ones. In the male, the right antenna alone has the swelling and hinge-joint which characterize the sex. Antennules (Fig. 2) bifid; two branches of unequal length, arising from a common stalk. The shorter of the two can be carried backwards or forwards at pleasure of animal, and is composed of three articulations, the first of which is short, and inserted into common foot-stalk; the second is furnished on its edge with a dozen of small dentations, from which arise as many hairs; and the third is provided at extremity with three long hairs.\* The longer branch is also composed of three articulations; the first articulated with body of animal; the third terminates in several long filaments, which have an articulation in the middle of the length, adding much to their suppleness.† Internal mandibles (Fig. 3) resemble somewhat those of preceding species, but have the “barbillons” much larger and bifid, while the

\* This part of the antennule is what Muller calls the *palpi*.

† This portion is what Muller describes under the name of *remi*.

neck terminates by a horny acute point, under which are six small teeth on the same plane. This horny point, Jurine thinks, replaces in some degree the external mandibles, which in this species are wanting; and thus not having an organ by means of which to seize its prey, it uses its antennules for that purpose, putting them into rapid motion, causing a regular whirlpool in the water, which attracts every object into its centre, where is situate the mouth. Behind the mandibles, and a little lower, are two small round bodies, almost transparent, which do not exist in the preceding species. These two bodies, when the animal eats, separate from each other so as to open a passage for the food, which is seen to pass through the opening thus made. Jurine calls these the lips. They are furnished with a barbillon (Fig. 4,) which consists of three parts, internal, middle, and external, all provided with hairs. Hands (Fig. 5,) different from those of *quadricornis*, each divided at their origin into two distinct parts—anterior, smaller of two, may be called the thumb, and is composed of three rings, the anterior edge of which is rough with small eminences, from which spring a number of pretty long hairs directed towards mouth; the posterior part is much larger, and consists of six rings, the two first very large in proportion to the other four.\* Feet (Fig. 6) are the same as in *C. quadricornis*. Under the last segment of body in the male, we perceive two stalks, almost cylindrical, both arising from one common base. (Fig. 7.) The right one consists of five segments, and is terminated by a strong hook; the left one has only four rings, and is shorter. These bodies are considered as the sexual organs by Jurine, the shorter of the two stalks containing, he believes, the organ itself.† In same situation, in the female, we find the *fulcra* or “supports” (Fig. 8) which Muller calls “*uncinuli*,” and which are of a very irregular shape; and underneath the first ring of tail is the vulva, through which also the eggs pass into external ovaries. Above the vulva we see a triangular reddish body, which Jurine calls *operculum vulvæ*. In some specimens of this species, we occasionally see on each side of the tail, two, four, or six elongated bodies, the direction of which is always backwards. In females, they are found adhering round the *operculum vulvæ* by a long and slender petiole, from which issues a sort of demi-capsule, which Jurine compares to an acorn. From this envelope springs a cylindric transparent body, which shows in its interior a longitudinal opaque line. These are what Muller calls the *lacinia*, which he regards as some particular organs belonging to the

\* These organs, the hands, are what Muller describes under the name of *laminæ radiatæ*.

† These are the “*Spicula duo curva*” of Muller.

animal, and are sufficient, he considers, to constitute it into a distinct species, named by him *C. lacinulatus*. At first observing them, Jurine says he was disposed to consider them also peculiar organs, and that it was a distinct species. After very attentive observation, however, he found the number to be irregular; and sometimes he found them in males adhering to the base of the posterior feet; he found them to separate spontaneously from the body of the animal, and, in short, discovered them to be nothing less than *animalcules*, the base upon which they were planted being a kind of moss, with which these insects are often covered. Jurine says that it is in the months of March and April that these insects are to be met with; but the only time I ever saw a specimen with these peculiar bodies adhering was in the month of October. It was taken from Yetholm Loch, Roxburghshire; but an accident occurring to the vessel in which they were placed, prevented me from any lengthened observations upon them. I have not met with the *C. cæruleus* of Muller; but Jurine distinctly asserts, that the three species of Muller, *cæruleus*, *rubens*, and *lacinulatus*, are mere varieties of one species; and which, from the resemblance he fancied he saw in the tail of the female, when loaded with eggs, to that of the beaver, he has named *Monoc. Castor*. It is a very beautiful species, and is the most elegant of all we know. “*Son port,*” says Jurine, “*est élégant; sa manière de s’élancer dans la liquide est noble et hardie; ses mouvemens sont libres et faciles; tout enfin annonce chez lui une supériorité qui characterize la grandeur de l’espèce à laquelle il appartient.*”

3. *Cyclops minutus*, Plate IX. Fig. 1–14. *Specific Character*.—Antennis curtis; corpore lineari; cauda biloba; lobo utroque setis duobus inæqualibus instructo; ovario externo unico.

*Synonimes, &c.*—*Canthocarpus Staphylinus*, *J. O. Westwood*, Lardner’s *Cab. Cycl.* (ined.)

*Cyclops staphylinus*, *Desmarest*, *Consid. gen. sur les Crustacés*, p. 363.

*Monoculus staphylinus*, *Jurine*, pp. 74–84, pl. 7, fig. 1–19. 1820.

*Cyclops minutus*, *Ramdohr*, pp. 10–13, tab. iii., fig. 1–9. 1805.

*Monoculus minutus*, *Fabricius*, *Tom. ii.* p. 499, No. 45. 1792?

*Cyclops minutus*, *Muller*, p. 101, tab. xvii. fig. 1–7.

*Amymone* (young state,) *Muller*, p. 42, tab. ii. 1785.

*Eichhorn*, *Beytrage zur Naturg. der Kleinsten Wasserthiere*, p. 53, tab. v. fig. K, L. 1781. *Very bad figures.*

Do. do. (young state,) p. 41, tab. iii. fig. p.

Satyr, *Baker*, *Employ. for Micros.* (the young state,) p. 314, pl. 12, fig. 23, 25, 26. 1764.

*Philosophical Transactions*, No. 288, for November and December, 1703.

*Habitat*.—Pools and ditches. Common all the year round.



*Description.*—Body and tail not distinctly separated from each other; composed of ten segments, first segment largest, last one, terminating in two short lobes, from which issue two long filaments, slightly serrated on their edges. At the junction of the fifth with the fourth articulation, the body is very moveable, and the animal frequently turns up the posterior extremity upon the anterior, in the manner of the species of beetle called *Staphylinus* (Plate IX. Fig. 1.) Jurine has taken the trivial name of *Staphylinus* from this circumstance, objecting to the name of *minutus* by which Muller designates it, as he says it is possible we may find still smaller species. I have, however, retained the name which Muller gave it, as he is the first author who has given any lengthened description of it. The males are smaller than the females—antennæ, (Fig. 1, 2, *aa*) very short compared with those of preceding species. In female (Fig. 3) composed of nine articulations; in male (Fig. 4.) only of seven. Between fourth and fifth articulation, in both sexes, we see a small lateral ring, of one short articulation and three or four short setæ. In male both antennæ have swelling and hinge-joint, the swelling existing chiefly about the fifth articulation, all the five first, however, being of greater size than the corresponding ones in the female; hinge-joint near the extremity. Antennules\* (Fig. 5.) composed of two articulations: upon first articulation is placed a small shoot terminated by four setæ, second articulation furnished with seven short spines on upper edge, and terminated by four longer ones. Jurine makes the antennules consist of six articulations, and his figure of these organs differs entirely from mine, which, after frequent and repeated examinations, never varied in their appearance in the slightest. Mandible (Fig. 6.) in figure resembles very much the internal mandible of the quadricornis, the “barbillon” springing from the centre, and consisting of three articulations, terminated by several setæ. The lips in this species are easily to be seen, and are provided also with a “barbillon,” which is a pretty large oval body (Fig. 7.) dividing at extremity into four fingers of equal length, each furnished with three setæ. Hands (Fig. 8.) of more simple organization than in the preceding species. They consist of three articulations, the last of which appears to be a very fine hook, forming with the other two, an angle always directed forwards towards the mouth. These hooks appear to stop all molecules of food in their passage, and by their constant motions carry them to the mandibles. Feet (Fig. 9, 10,) much longer in proportion than in either of the preceding species, and differing in some respects from each other. The

\* “Palpi” of Muller.



first pair (Fig. 9,) has both stalks divided into three articulations, the external (*a*) has all three of nearly an equal length, whilst the internal (*b*) has the first articulation nearly as long as all the three of the external together, but the two last are short and inclined outwards. The three other pairs (Fig. 10,) have the internal stalk shorter than the external; both consist of three joints, though Jurine says the external has five: the last pair are the longest of all. The fulcra or supports (Fig. 11,) are situate under fifth segment, and consist each of a broad flat body, from one side of which issues an appendage or kind of finger furnished with several hairs, the opposite side being rounded, and also giving off a number of setæ. In the same place in the male are situate the organs of generation. At the base of sixth ring in female are the openings of the canalis deferens, and under sixth and seventh segments the adults of same sex carry a very singular, horny looking, club-shaped organ, which is fastened to the body by a narrow elongated stalk. It is somewhat curved and directed backwards, its colour almost always more or less red. This organ is not found in the young female, till after she has several times laid eggs. Its hardness is greater than that of the shell of the animal; its use is not known. Jurine has seen two in one female, one red, the other black. In copulation, the male of this species lays hold of the terminating segment of the tail just above the commencement of the long filaments which issue from it, as represented by Muller in his plate of this species.

#### B. Marine Species,

4. *Cyclops chelifer*, Plate IX. Fig. 15-22. *Specific Character*.—Antennis brevibus; capite rostrato; manibus chelatis; cauda biloba; setis duobus longitudine corporis; ovario unico.

*Synonymes*.—*Cyclops chelifer*, Muller, p. 114. tab. xix. Fig. 1-3.

*Cyclops Johnstoni*, Baird, Transactions of Berwickshire Naturalists' Club, p. 97. plate 2. fig. 4.

*Habitat*. Sea shore of Berwickshire, as at Cockburnspath, Berwick bay, &c.

*Description*.—Body of 4, tail of 6, segments—terminating one giving issue to two long, linear, finely serrated setæ, fully the length of the body; upper or cephalo-thoracic segment of body beaked, or having a short conical proboscis in centre. Antennæ (Fig. 16) short, of about 10 articulations in female—at junction of fourth with fifth, is a small lateral ring in both sexes. About fifth ring in male (Fig. 22) is the swelling, which is in the form of a bulla or bladder, followed by the hinge-joint. Antennules (Fig. 17) of two articulations, as in *minutus*; the first having a shoot sent off from about its centre, consisting of two articulations, furnished with several setæ; the

second terminated by five setæ, the three internal being longest, and having a joint near the middle of their length. The mandibles appear to resemble very much those of *minutus*, the teeth, however, being more distinctly seen; and the barbillons of lips are also very like those of preceding species; but, from the rigidity of the parts in the specimens from which my figures were taken, I could not sketch these minute organs properly. Hands (Fig. 18) of three articulations; the first one long; the second short, thick, and curved; the third being a strong curved hook, the two latter together having the appearance of a very strong claw. First pair of feet (Fig. 19) consist of two unequal stalks arising from a common base; superior stalk (*a*) the longer of the two, composed of two nearly equal stalks serrated on upper edge; the second terminating in three short hooks; the inferior stalk (*b*) also of two articulations, the first of which is much the longer of the two, and serrated, the second being very short, and terminating in two curved hooks. The three other pairs of feet (Fig. 15 and 20) consist, each stalk, of three articulations, furnished with long hairs, one or two of the long terminating ones being finely serrate; external stalk (*a*), as in *minutus*, larger and longer than internal; all three pairs of feet resemble each other. Supports or fulcra (Fig. 21) consist, each, of a broad flat body, rounded at one side, and furnished with several pretty long finely serrated setæ; the opposite side giving off an appendage or finger, also provided with several serrated setæ. This species I have named *chelifer*; but it differs from the figure and description of Muller's *chelifer* in so many points, that in a paper upon the Berwickshire Entomostraca, read before the Berwickshire Naturalists' Club, and since that, published in their Transactions, I made a distinct species of it, and named it *Cyclops Johnstoni*. Upon more minute examination, however, I have again changed its name, restoring to it that of Muller, as it approaches, notwithstanding its discrepancies, sufficiently near that species of his, to be identified with it. In Muller's species, he says there are no articulations to the body, which he describes as "farciminis facie," and there are only three articulations to the antennæ. These characters are so much at variance with the analogous portions of the body in all the other species, that, as he mentions it as a rare species, it is most probable Muller must have made some mistake with regard to them. Some differences also exist in the first pair of feet, and the length of the caudal setæ—but they agree so well in the very characteristic hands, in the beaked head, &c, that I have now no hesitation in referring my species to Muller's *chelifer*.

5. *Cyclops Stromii*.—Plate IX. Fig. 23-25. *Nova species*.—*Specific Character*.—Antennis curtis; capite rostrato; manibus unguiculatis, cauda biloba, setis duobus brevibus instructa; ovario externo unico.

*Habitat*. Shore at Coekburnspath, Berwiek bay, &c.

*Description*.—Body and tail, as in the others, consist of ten segments, gradually tapering to extremity without any very decided difference between tail and body. First segment the largest, furnished with a conical beak—last segment terminating in two lobes, which give issue to two setæ, much shorter than in the preceding species, being scarcely half the length of the body. Antennæ of about eight articulations; at junction of fifth with sixth, having a lateral ring. In male (Fig. 25) the swelling and hinge-joint are as in preceding species. All the articulations of the antennæ throw forward one or more short setæ. Antennules, as in the preceding species, of two articulations, the second being terminated by about four pretty long setæ. Mandibles were not seen; hands, like those of *C. minutus*, consist of two articulations, and a pretty strong hook, which points upwards. First or thoracic pair of feet have the external or superior stalk much smaller and shorter than the other, and is divided into three joints, the last of which is terminated by three pretty strong setæ or small hooks. The internal or inferior is much the longer of the two, and consists of two articulations, the first being very long in proportion to the second, which is exceedingly short and terminated by a curved hook. The abdominal feet are exactly the same as in last species—and the fulcra or supports which I could not examine accurately, seemed to be also similar to those of the *chelifer*. I have named this species after Ström, who has given a description of a species of *Cyclops* in the *Acta Hafniæ*, 9th vol. which has some resemblance to this, as translated by Muller in his *Entomostraca*, under the name of *C. brevicornis*.\*

6. *Cyclops furcatus*. Plate IX. Fig. 26-28. *Nova species*.—*Specific Cha-*

\* In the edition of the *Acta Hafniæ* in the British Museum, the figures which Ström gives of the *brevicornis* are unfortunately wanting. In Muller's description of the *brevicornis*, which he professes to take from Ström, he says the tail setæ are very short, "setis caudæ brevissimis," while Ström in his description says they are very long, "setis caudæ binis longissimis"! In my paper in the *Transactions of the Berwickshire Naturalists' Club*, I have quoted the species described above as the *C. brevicornis*, taking the description as given by Muller, not having at that time seen the *Acta Hafniæ*—and not being aware of the discrepancy which exists between the two descriptions. Vide Ström's paper in "Det Kiøbenhavn'ske Selskabs skrifter," 9th vol. p. 590, 1765.

racter.—Antennis furcatis; capite brevi-rostrato; manibus unguiculatis; ovario externo unico, magno.

Habitat.—Berwick bay.

Description.—Body and tail distinctly separate from each other, of ten segments, the first the largest, the last terminating in two short lobes from which issue two long setæ, more than half the length of the body, and two others about half the length of the former. First segment furnished with a short beak. Antennæ very distinctly forked, consisting of about seven or eight articulations. Fork taking place at fourth articulation—upper limb not articulated, longer than lower limb, which is divided into three or four articulations. Each articulation throws upwards and forwards a tuft of short setæ. Antennules of two joints, the latter terminating in three or four pretty long setæ. Mandibles were not seen. Hands of two articulations and a curved hook pointing upwards, as in *minutus*. Thoracic or first pair of feet (Fig. 28) have the superior or external stalk the longer of the two, of two joints, first short, second longer, having a strong tooth or process on inferior edge, and terminating in three or four short curved setæ or hooks. Inferior or internal stalk of three articulations; first short and thick; second longer and broad; third short and terminated by two pretty long straight setæ or hooks, and five or six curved ones, each gradually becoming shorter than the others. Abdominal legs as in the other species above-mentioned. Fulcra or supports have the appendage or finger in the form of a long, slender, slightly curved stalk, toothed or serrated on the upper edge, and terminating in three or four hairs. The external ovary is single, large, and generally lying across the tail, in consequence of which perhaps the insect generally swims prone or supine, seldom swimming on lateral surface, as most of the other species do. I have only met with three or four specimens of this species, all females; and in two or three of these, there was attached to the dorsal surface of the fourth segment of the body, a substance very much resembling a polype (Fig. 26,) consisting of a pedicle and three branches, each branch terminated by four short fingers.

7. *Cyclops depressus*. Plate X. fig. 9–12.—*Nova species*.—*Specific Character*.

Corpore lati-depresso; antennis brevibus; cauda biloba, setis duobus brevissimis instructa.

Habitat. Berwick bay.

Description.—Body depressed, flat and broad, differing in this respect very much from all the other species described; of four segments, the first of which is much the largest, being more than equal to the three succeeding ones, and having the upper part projecting



in a short obtuse point ; tail about one-third the length of the body, terminating in two very small lobes, from which issue two very short setæ. Eye situated rather lower down than usual in the other species, of a fine ruby colour. Antennæ short, strong, subcylindrical, setiferous, of about six articulations ; in the female having a lateral ring at junction of fourth and fifth ; swelling in the male, (Fig. 10) situate in the fourth, followed by the usual hinge-joint, and terminating in a hook. Antennules of two articulations, the latter being terminated by about four short setæ. From opaqueness of body and flat form, I could not distinctly perceive the mandibles or hands, except that the latter were terminated by a curved hook as in *minutus*, &c. Thoracic pair of feet consist of two stalks as usual, rising from one common base, each stalk consisting of three distinct joints, (Fig. 11.) Superior or external stalk longer than inferior one, the last joint terminating in four short hooks. Inferior stalk terminated by several short setæ, and having a long seta given off at each joint. Abdominal legs, of the same form and structure as in the other species, and provided with numerous long hairs or setæ. Sexual organ of male ? (Fig. 12,) very large, consisting of a broad plate issuing from junction of first with second segment of tail, terminating in a pretty long, bluntish, hollow spine, and having four short teeth or hollow spines on outer edge ; the whole organ being nearly of an equal length with the tail. In the female the fulcra or supports issue from same place, and so nearly resemble the male organ as to make them appear the same. They are not so broad, however, and have only two lateral teeth, both of which are situate near the base. In the female the second segment of tail is much larger than in male.

The posterior two-thirds of thoracic segment is marked with a broad fascia of a very dark colour, with a ruby tinge in it. Two upper segments of tail are marked in the same manner, but not of so deep a colour. I have met with but few specimens of this very pretty species, and never with a female with ova.

The motion of this insect is peculiar. It generally swims on its back, and instead of darting *forward* through the water, as the other species of *Cyclops* do, it springs with a bound from the bottom of the vessel where it rests when undisturbed, *up to the surface* of the water. For this purpose it curls its body up into the form of a ball, and then suddenly returning to the straight position, springs with a sudden bound from the bottom to the surface, falling gradually down again to the same place from which it sprung.

I have noticed one or two other marine species of *Cyclops* on the



coast of Berwickshire, but not having correct sketches of them, I shall not take notice of them here.

(To be continued.)

*Explanation of Plates.*—Plate VIII. Fig. 1, female of *C. quadricornis*, var. *viridis*, lateral view, (a) body; (b) tail; (c, c) antennæ; (d, d) antennules; (e, e) feet; (f, f) plumose setæ of tail; Fig. 2 (a, a) antennæ of male, to shew the peculiar swelling and hinge-joint; Fig. 3, tail of var. *albidus*, to shew the external ovaries; Fig. 4, internal mandible, (a) body; (b) neck; (c) “barbillon;” Fig. 5, external mandible; Fig. 6, hand; (a) internal portion, or thumb; (b) external do; Fig. 7, feet, first pair; Fig. 8, ovum at maturity; Fig. 9, young, a few hours after birth; Fig. 10, young, eight days old; Fig. 11, young, fifteen days old; Fig. 12, young after first moulting; Fig. 13, tail of male, to shew organs of generation; Fig. 14, female of var. *rubens*, to shew internal ovaries.

Plate IX. Fig. 1, female of *C. minutus*; (a, a) antennæ; Fig. 2, male of do; (a, a) antennæ; Fig. 3, antennæ of female; Fig. 4, do of male; Fig. 5, antennule; Fig. 6, mandible; Fig. 7, “barbillon” of lips; Fig. 8, hand; Fig. 9, thoracic or first pair of feet; (a) external stalk; (b) internal do; Fig. 10, second pair of feet; Fig. 11, fulcrum or support; Fig. 12, young just born; Fig. 13, young, eight days old (in October); Fig. 14, do. fifteen days old (October) Fig. 15, female of *C. chelifera*; Fig. 16, antennæ of female; Fig. 17, antennule; Fig. 18, hand; Fig. 19, thoracic or first pair of feet; Fig. 20, second pair of feet; Fig. 21, fulcrum or support; Fig. 22, male antenna; Fig. 23, female of *C. Stromii*; Fig. 24, first pair of feet; Fig. 25, antenna of male; Fig. 26, female of *C. furcatus*, in supine position, shewing external ovary and polype like body; Fig. 27, do. lateral view to shew its various members; Fig. 28, first pair of feet.

Plate X. Fig. 1, *C. castor*; Fig. 2, antennules; Fig. 3, internal mandible; Fig. 4, barbillon of lips; Fig. 5, hand; Fig. 6, feet, first pair; Fig. 7, male organs; Fig. 8, fulcra or supports; Fig. 9, female of *C. depressus*; Fig. 10, male of do; Fig. 11, thoracic or first pair of feet; Fig. 12, male sexual organ.

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II.—*Observations on the Germination of Ferns.* By Mr J. HENDERSON. Plates XI. XII.

THE first account of the germination and raising of ferns from spores was given by Mr Lindsay, in a paper read before the Linneæan Society, January 3d, 1792, and published in 1794 in Linn. Trans.